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ABSTRACT

This study was conducted to assess the first year of full implementation of a teacher incentive program (TIP) in South Carolina. The study examines the relationship between student achievement and teacher participation in one of several incentive model programs. The research also explores award winning teachers and their association with higher gains by students in reading and mathematics achievement scores. A stratified random sample of schools was selected from which all TIP award recipients and a matched control sample of nonparticipants were selected as subjects, limiting the study to classroom teachers of reading and/or math in grades 1-6 during the 1988-89 school year. Relevant characteristics for all teachers and their classes were recorded, along with achievement data for students. Results demonstrate that participants in TIP are associated with higher gain scores in reading and math than nonparticipants, and suggest that screening candidates for teaching awards is consistent with the goals of performance-based compensation programs. (LL)

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PARTICIPATION IN A TEACHER INCENTIVE PROGRAM AND STUDENT ACHIEVEMENT IN READING AND MATH

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Prepared for presentation at the Annual Meeting of the American Statistical Association in Atlanta, GA, August 22, 1991. This paper is based in part on a report submitted to the South Carolina Department of Education, entitled *Assessment of the 1988-89 Teacher Incentive Program: Component Two*, December 1990, pursuant to a contract granted to the Division of Research, College of Business Administration, University of South Carolina.

INTRODUCTION

INCENTIVE SYSTEMS FOR TEACHERS

The decade of the 1980s has witnessed a remarkable resurgence of interest in and concern about the nation's teaching force, demonstrated in part by the fact that virtually every state has enacted new policies governing teacher education, licensing, and compensation. Perceiving that their own state economies were at stake, governors, business leaders, and legislators have led the charge in the "first wave" of teacher reform. In their efforts to reverse the decline of the quality of the teacher workforce, these decision makers ushered in new policies to: 1) assess the competencies of teachers through proficiency tests and tougher evaluations; and 2) provide incentives for attracting talented teachers through salary increases, merit pay programs, and career ladders. By the end of 1986, 29 states had initiated, piloted, or mandated alternative compensation structures through merit pay, career ladder, or other teacher incentive programs.

State efforts to enact and implement performance compensation systems for teachers have been quite visible. Proponents claim that performance-based compensation systems will 1) meet the public's concern for teacher accountability; 2) enhance the status of teachers; 3) motivate teachers to teach better; and 4) attract and retain talented teachers.

Several states - including Georgia, Florida, Kentucky, Alabama, Utah, Tennessee, and South Carolina - have taken the lead in mandating the use of student achievement data as a criterion for identifying superior teachers for incentive pay. Because of the assumption that improved student performance is

the "bottom line" in determining who is or who is not a "meritorious" teacher, measures of student achievement are a significant component in these states' teacher incentive programs. However, more often than not, states are having problems in implementing this component. For example, in Arizona, career ladder pilot districts are "backing off" on the student achievement component - primarily because school districts are "not comfortable that they have good measures" and they recognize that "it takes a while to standardize" the procedures for teachers and to "make it fair" (Olsen, 1987).

It is important to note that performance-based compensation systems for teachers have come and gone for over 70 years. Historically, most of these systems failed within five years due to inadequate methods for judging meritorious teaching, administrative problems, and insufficient funding (Murnane and Cohen, 1984; Johnson, 1984). During the recent school reform movement, the greatest challenges to the implementation of performance-based pay plans have been both technical and political in nature.

The South Carolina Teacher Incentive Program

As required by the Education Improvement Act (EIA) of 1984, the South Carolina State Board of Education has implemented an incentive program that "rewards teachers who demonstrate superior performance and productivity." In 1985-86, the legislature appropriated $2.2 million, and three program models (Bonus Model, Campus/Individual Model, and Career Ladder Model) were piloted in nine school districts. In 1986-87, the legislature appropriated $6 million, and the Models were piloted in 17 school districts. In the third pilot year, 1987-88, the legislature appropriated approximately $12 million, and the Models were tested in 44 school districts. The 1987-88 pilot-test was implemented in

school districts which serve approximately 60 percent of the state's K-12 public school students. After pilot-testing, the Bonus and Campus/Individual Models were selected for statewide implementation. A brief description of the Bonus and Campus/Individual Models follows:

Bonus Model

To receive an award under the Bonus Model, candidates must demonstrate a superior record of performance in each of the following four areas:

1. **Attendance** - Candidates must have an attendance record of no more than ten days of absence (out of 190-day contract year) during the year of consideration.
2. **Performance Evaluation** - Candidates must be evaluated with a district instrument and obtain a rating determined through an appropriate standard-setting procedure to represent superior performance. Importantly, individual teacher performance must be "evaluated with a school district instrument which meets state criteria established by the State Board of Education for instruments used to evaluate Annual and Continuing Contract Teachers."
3. **Self-Improvement** - Candidates must demonstrate evidence of self-improvement through advanced training. As a result, candidates are required to complete at least one self-improvement activity from the list of approved advanced training options.
4. **Student Achievement** - All candidates are required to be evaluated for teaching performance as it relates to improved student learning and development.

Teachers meeting the requirements receive an award of not less than $2,000 and not more than $3,000.

Campus/Individual Model

The Campus/Individual Model establishes an incentive plan containing two separate components. The Campus Plan of the Model, which receives from one-third (1/3) to two-thirds (2/3) of the district's TIP funds, collectively rewards staff members in schools that attain superior levels of student achievement. Such schools will receive incentive funds to be distributed among eligible staff members. The intent of this approach is to reward eligible teachers in a school for working together as a team to positively influence student achievement. Under the Campus Plan, no eligible faculty shall receive an award which exceeds $3,000.

The Individual Plan of the Model, which receives from one-third (1/3) to two-thirds (2/3) of the district's TIP funds, rewards individual school staff members for superior performance as detailed under the Bonus Model description without respect to overall school performance. Under the Individual Plan, no award shall be more than $3,000 or less than $2,000. For teachers who qualify under both Plans, no combined award shall exceed $3,000.

Model Development

The initial three teacher incentive program Models were developed during the 1984-85 school year with the assistance of the Teacher Incentive Program Advisory Committee (TIPAC) and several consultants. TIPAC, together with the staff of the State Department of Education (SDE), formulated criteria and procedures to fund a number of school districts for the development of model plans by October 1984. All school districts in South Carolina were then invited

to submit proposals for developing model plans. Eleven school districts were selected by the State Board of Education to participate in the model development process, each receiving grants of up to $30,000 for the effort.

Elements of the model plans submitted by the eleven selected school districts were reviewed and amalgamated into three program models by the SDE staff and TIPAC. These recommendations were reviewed by the Select Committee in December 1984 and approved by the State Board of Education in January 1985. The final selection of the three teacher incentive program Models was recommended by SDE staff and TIPAC, reviewed by the Select Committee and the Joint Subcommittee in April 1985, and approved by the State Board of Education in May 1985. The three program Models encompassed exemplary features of the eleven district model plans in three distinctly unique formats.

During the pilot-test phase, funds for the program were allocated to the districts on a formula (per pupil) basis. Funding for total implementation of the program was structured to enable up to 20 percent of each district's teachers to receive an award of $3,000. Twenty percent of the district's TIP monies or $3,000, whichever was greater, was to be used to cover operational costs.

The three Models which emerged from the initial developmental process were the Bonus, Career Ladder, and Campus/Individual. Each Model was administered by a district-wide incentive committee with substantial teacher and principal representation. The committees set district procedures, screened applicants, approved each candidate's incentive plan objectives, and met with all approved candidates in an exit interview in order to evaluate evidence which verified attainment of approved incentive plan objectives.

To be eligible for an incentive award, a participant must have been employed in the district prior to the initial application deadline as well as

have achieved "professional status." For TIP purposes, candidates achieved "professional status" when they 1) were classified as a full-time employee; 2) were paid on the regular teachers' salary schedule (which means that guidance counselors, media specialists, etc., were eligible); 3) achieved continuing contract status; and 4) had at least two years of teaching experience in South Carolina.

At the conclusion of the first year of pilot-testing, the Models were revised with TIPAC's recommended changes for each of the Models. These recommendations pertained to teacher eligibility, program administration, and procedures.

At the conclusion of the second year of pilot-testing, the Models were revised to include TIPAC's changes and the Joint Subcommittee recommended to the State Board of Education that the Career Ladder Model be eliminated from the 1987-88 pilot-testing. MGT of America, Inc., provided an assessment of the implementation of the 1987-88 pilot testing. In its most recent report MGT (1989) noted that:

- 24 percent of the initial participants withdrew from the program due to the time and additional work required,
- 78 percent of the remaining participants received an incentive award, and
- a slight relationship was found between school gain indices and the percentages of teachers who received individual incentive awards in the Campus/Individual Model.

In 1988-89, TIP was implemented in each of the state's 91 school districts and three state agencies. During that year 23 school districts or state agencies implemented the Bonus Model while 71 districts implemented the Campus/Individual Model. Preliminary data indicate that, for the Bonus Model, 1,647 teachers participated - which represented 16 percent of the total number of teachers in

the 23 school districts. Of the 1,647 teachers who participated in the Bonus Model, 1,336 were awarded the $2000 to $3000 bonuses while 190 were disqualified. Of these 190 teachers:

- 26 percent were disqualified because of the attendance criteria,
- 4 percent were disqualified because of the self-improvement criteria,
- 28 percent were disqualified because of the performance evaluation criteria, and
- 42 percent were disqualified because of the student achievement criteria.

With regard to the Individual Plan of the Campus/Individual Model, 3,558 teachers participated - which represented 13 percent of the total number of teachers in the 71 school districts. Of the 3,558 teachers who participated in the Individual Plan, 2,494 were awarded the $2000 to $3000 bonuses while 776 were disqualified. Of these 776 teachers:

- 12 percent were disqualified because of the attendance criteria,
- 18 percent were disqualified because of the self-improvement criteria,
- 12 percent were disqualified because of the performance evaluation criteria, and
- 58 percent were disqualified because of the student achievement criteria.

With regard to the Campus Plan, 95 percent of the total number of schools (within the 71 districts) participated. Of the eligible teachers, 5,248 were awarded bonuses in the range of $208 to $3000. In addition, 1,091 teachers within the Campus Plan were disqualified. Of these 1,091 teachers:

- 89 percent were disqualified because of the attendance criteria,
- 1 percent were disqualified because of the self-improvement criteria, and

- 10 percent were disqualified because of the performance evaluation criteria

The Present Study

The purpose of the present inquiry is to provide an assessment of the first year of the full implementation of the Teacher Incentive Program in South Carolina. The main issue before us is the following question: What is the relationship between students' achievement and their teachers' participation in the Bonus Model or the Individual Plan of the Campus/Individual Model? Specifically, are teachers who received an award associated with higher gains by students in reading and mathematics achievement scores? To attempt an answer to this difficult question, we have selected a stratified random sample of schools from which all TIP award recipients and a matched control sample of nonparticipants have been selected as subjects, limiting the study to classroom teachers who taught reading and/or math in grades 1-6 during the 1988-89 school year. Relevant characteristics for all teachers and their classes have been recorded, along with achievement data for students. A more detailed analysis of data collection and statistical analysis follows in the next two sections.

Sample Selection and Data Collection

Sample Selection

The sample selection technique employed in the present study is a multi-level stratified random sampling of districts and schools. In the first stage, 22 school districts were randomly selected, 14 districts participating in the Campus/Individual Model and 8 participating in the Bonus Model, using a random number table. To insure that the largest districts in the state would be represented in the study, the school districts of Charleston, Greenville and

Richland 1 were forced into the sample. In the second stage, again using a random number table, 70 schools were selected from the 14 school districts using the Campus/Individual Model and 57 schools were selected from the 8 districts using the Bonus Model. The matched sample was selected on the basis of the following characteristics: grade level, field of teaching, age, sex, race, educational preparation, and teaching experience.

To ascertain that the sample districts were representative of the entire state, we compared attributes of the 22 districts to the state as a whole. Variables used in the analysis were the dropout rate, average years of experience of the teaching staff, percentage of the teachers who are male, average salary of the teaching staff, and assessed valuation per pupil of real property. Data for these variables suggest that our sample is representative of the state as a whole since none of the t ratios are statistically significant at $p = 0.05$.

In addition, the selected districts were located on a South Carolina map to assure that the sample districts were chosen from each of the Congressional districts and each of the major regions of the state.

Data Collection

The SDE notified by letter each school district selected for the sample. Several of the districts were contacted by telephone and preliminary interviews were scheduled with selected TIP coordinators or other district representatives. Each school district was then contacted by telephone to request cooperation and explain the nature of the research as well as the data required from the school districts. Letters were also sent to selected school superintendents to verify the data requested by telephone. In addition, two tapes of student achievement scores were obtained from the SDE - the second tape included teachers names for

the school district which indicated that achievement tests for elementary students were administered by the students' classroom teacher.

As data were received either from the school districts, the schools, or the teachers, the class rolls were matched to students' names from the tapes of achievement scores, with the exception of one school district. In the latter case, teachers' names were matched to the test administrators' names.

STATISTICAL ANALYSIS

GAIN SCORES

The first step is to compute gain scores for each student in our sample. Using the regressions in Table 1 (provided by the S.C. Department of Education), we computed the following:

(1) $P(R_g) = b_{1rg}R_{g-1} + b_{2rg}M_{g-1} + b_{3rg}R_{g-1}^2 + b_{4rg}M_{g-1}^2 + b_{5rg}RM_{g-1} + C_{rg}$

where $P(R_g)$ is the predicted value of the reading achievement score in grade g for the student based on his/her performance in the prior year (grade g-1)

b_{irg} is the relevant (ith) regression coefficient for the reading equation in grade g - 1 (from Table 1)

R_{g-1} and M_{g-1} are the student's actual reading and math scores in the prior grade, respectively

R^2 and M^2 are the respective squares of the scores

C_{rg} is the constant term (also from Table 1), and

RM_{g-1} is given by the following formula:

(2) $RM_{g-1} = (R_{g-1} - R_{s,g-1}) \times (M_{g-1} - M_{s,g-1})$

where $R_{s,g-1}$ and $M_{s,g-1}$, respectively, are the state means for reading and math scores in the prior year. The state means are shown in Table 2.

TABLE 1

RESULTS OF IMP AND RMP REGRESSION ANALYSES BY GRADE
Dependent variable is achievement score on CTBS for grades 4 and 5, and SC Basic Skills Assessment Program for grades 1-3 and 6

Gr	Post		R	M	R^2	M^2	RM	Const.	Mult RSQ	RMSE
	IMP	R	5.9147*	NA	.0421*	NA	NA	258.744	.2646	80.4990
1		M	4.3156*	NA	.0036*	NA	NA	392.644	.2716	77.4501
	RMP	R								
		M	No Analysis Conducted							
	IMP	R	.6147	.0865	-.0010	-.0004	.0007	224.686	.4164	72.1120
2		M	.3422	.2169	-.0003	-.0009	.0004	353.127	.2476	74.7959
	RMP	R	.5715	.1428	-	-	-	287.039	.3000	71.7342
		M	.1426	.3205	-	-	-	479.610	.1435	75.3379
	IMP	R	.5243	.1548	-.0011	-	.0006	252.843	.4391	64.1392
3		M	.3614	.3827	-	-.0008	.0010	204.288	.2784	93.0775
	RMP	R	.5838	.0813	-	-	-	295.204	.3050	62.0800
		M	.1140	.4776	-	-	-	368.876	.1985	81.7751
	IMP	R	.4308	.1233	-.0012	-.0001	.0006	240.627	.5106	42.2937
4		M	.1332	.1151	-.0003	-.0002	.0003	487.393	.4331	22.6734
	RMP	R	.6565	.1858	.0011	-	-	127.762	.5214	38.9423
		M	.0521	.4716	.0001	.0008	-	335.938	.3651	19.9672
	IMP	R	.6800	.2249	-	-	-	87.143	.7255	27.9840
5		M	.0936	.4376	-	-	.0003	334.494	.6022	13.9365
	RMP	R	.7157	.1892	.0016	.0008	-	82.742	.5784	31.2937
		M	.0664	.4777	.0001	.0006	-	324.741	.4074	14.5323
	IMP	R	.9673	.9059	.0014	-	-	-551.653	.6785	56.8222
6		M	.5310	2.6360	-	.0101	-	-1455.548	.5413	74.1410
	RMP	R	.5117	.1901	.0003	-	-	233.051	.3634	58.2233
		M	.2041	.6113	-	.0003	-	156.277	.3546	69.3094

NOTE: R amd M refer to reading and math scaled pre-test scores; R^2 and M^2 are their squares (corrected to the mean) and RM is their product. A dash ("-") in a cell indicates that the criteria for inclusion were not satisfied; NA indicates not appropriate. RMP indicates results for repeaters while IMP indicates the results for non-repeaters. RMSE is the residual mean square error. CSAB is Cognitive Skills Assessment Battery. * refers to CSAB raw scores.

Source: S. C. State Department of Education.

TABLE 2

Means to be Used for Deviation Terms (Scores from Spring 1987)

Non-Repeaters

Prior Year Grade	Reading	Math
CSAB	94.3427	
1	844.834	805.025
2	811.757	814.477
3	799.015	806.851
4	679.721	684.378
5	703.607	698.120
6	776.892	768.796

Repeaters

Prior Year Grade	Reading	Math
2	670.748	699.768
3	689.887	686.444
4	598.363	643.168
5	637.640	669.330
6	685.554	667.071

Source: S.C. Department of Education

Predicted scores for math achievement are measured in a similar fashion as shown in Equation (3):

(3) $P(M_g) = b_{1mg}R_{g-1} + b_{2mg}M_{g-1} + b_{3mg}R_{g-1}^2 + b_{4mg}M_{g-1}^2 + b_{5mg}RM_{g-1} + C_{mg}$

where the subscript m refers to the variables and coefficients associated with math. Note that the coefficients for some of the right-hand side arguments are sometimes zero, in which case these items obviously disappear from the equation.

The gain scores are measured as residuals, as shown in Equations (4) and (5):

(4) $G_{gr} = [R_g - P(R_g)] \times 10 / MSE_{gr}$

(5) $G_{gm} = [M_g - P(M_g)] \times 10 / MSE_{gm}$

where G_{gr} and G_{gm}, respectively, are reading and math gain scores, and

MSE_{gr} and MSE_{gm} are, respectively, the mean squared errors for reading and math, shown in the rightmost column of Table 1.

Let G_{grij} be the reading gain score for the ith student in grade g taught by the jth teacher. Then we derive an average gain score for each teacher j, given by $AG_{grj} = \sum_{j} G_{grij}/n_j$, where n_j is the number of students taught by teacher j. An alternative measure would be the median gain score for the jth teacher, call it MG_{grj}. Average and median gain scores for math (AG_{gmj} and MG_{gmj}, respectively) are derived in a similar fashion.

The principal purpose of calculating these standard residualized gain scores is to facilitate analysis in which gain scores may be used for all grades together. This could not be done with raw scores or simple gain scores.

Cross Tabulations

Tables 3 and 4 provide a tabulation of average reading and math gain scores by grade and by teacher group. The number of observations (teachers) in each cell is provided along with the mean gain score and the respective standard deviation.

TABLE 3

Number of Observations (N), Means, Standard Deviations (SD), by Teacher Participation Group, of Average Reading Gain Scores, by Grade

GRADE	NONPARTICIPANTS			AWARD WINNERS					
				CAMPUS MODEL			BONUS MODEL		
	N	MEAN	SD	N	MEAN	SD	N	MEAN	SD
1	28	1.56	4.76	35	3.39	5.06	38	1.79	4.78
2	37	-2.03	5.43	28	-0.43	5.77	26	2.80	3.28
3	30	-3.96	13.49	38	-1.10	12.92	25	2.51	5.79
4	30	-3.46	8.25	21	-0.07	5.81	31	-2.22	4.69
5	21	1.43	3.89	11	1.54	3.20	27	1.43	4.82
6	9	2.38	3.39	7	1.28	3.09	21	6.17	4.09

TABLE 4

Number of Observations (N), Means, Standard Deviations (SD), by Teacher Participation Group, of Average Math Gain Scores, by Grade

GRADE	NONPARTICIPANTS			AWARD WINNERS					
				CAMPUS MODEL			BONUS MODEL		
	N	MEAN	SD	N	MEAN	SD	N	MEAN	SD
1	28	2.35	4.65	35	2.23	5.51	38	2.68	4.43
2	37	-1.30	5.02	28	1.06	6.28	26	4.17	4.17
3	30	0.41	7.47	38	1.92	11.36	25	2.65	6.10
4	30	-0.75	6.85	21	0.90	8.36	31	0.40	4.02
5	21	1.67	3.91	11	2.00	4.20	27	2.34	3.57
6	9	2.07	6.16	7	4.04	4.79	21	8.52	5.70

Reading

Concerning readings scores, we note that the means of average gain scores (Table 3) are higher for both the B (representing the Bonus Model) and C (representing the Campus/Individual Model) groups relative to the NP (control) group. However, there are a number of cases where the reverse is true or where the differences are rather small. Moreover, because of the relatively small sample sizes combined with the relatively large standard deviations, most of the pairwise comparisons were not statistically significant. Similar results were found for median gain scores.

Math

Whether one uses the average or the median gain scores (see Table 4 for average gain scores), mean gain scores are typically higher for both the B and C groups relative to the NP group. In addition, the B group tends to have higher mean gain scores more often than the C group. Again, the number of observations

is relatively small and the standard deviations relatively large, hence we do not find many pairwise comparisons to be statistically significant.

REGRESSION ANALYSIS

The Model

As noted earlier, the basis for the South Carolina Teacher Incentive Program is the assertion that "deserving" teachers should receive a financial reward. One of the cornerstones of the program is to reward teachers whose students gain relatively more in reading and math achievement. If the program works according to its design - which many teachers and other critics of TIP challenge - then we should expect to find a significant association between participation in the program and gain in achievement. In addition, the educational production function literature (for surveys see, e.g., Hanushek [1986], Monk [1990], and Cohn and Geske [1990], ch. 7) suggests that other classroom and teacher variables (among others) might affect reading and math performance. These variables are included in Equation (6), which is our basic regression model:

$$(6)\quad AG = a + b_1B + b_2C + b_3SEX + b_4RACE + b_5EXP + b_6BA + b_7BAPLUS + b_8MA + b_9GRADE + b_{10}CSIZE + b_{11}PCTBLACK + b_{12}PCTFEMALE + b_{13}PCTFRL$$

where

a= intercept;

B= 1 for award winners in the bonus model and 0 otherwise;

C= 1 for award winners in the campus/individual model and 0 otherwise;

SEX=1 for female teachers and 0 otherwise;

RACE=1 for black teachers and 0 otherwise;

EXP= number of years of teaching experience;

BA = 1 for teachers with a Bachelor's degree only and 0 otherwise;

BAPLUS = 1 for teachers with BA plus 18 semester hours and zero otherwise;

MA = 1 for teachers with a Masters degree and o otherwise;

GRADE= grade taught by teacher;

CSIZE= number of students in the class;

PCTFEMALE= percent of students in class who are female;

PCTFRL= percent of students in class who are eligible to receive either free or reduced-fee lunch;

b_1 - b_{13} are coefficients to be estimated by ordinary least squares analysis.

The principal hypotheses are that $b_1 > 0$ and that $b_2 > 0$. One could also hypothesize that $b_{13} < 0$, because poor students are often academically disadvantaged.

Results

The regression model was run four times: 1) for average gain scores in reading, 2) for median gain scores in reading, 3) for average gain scores in math, and 4) for median gain scores in math. Regression results are reported in Table 5.

The most consistent result shown in Table 5 is that, other things equal, teachers receiving an award in either the Bonus or the Campus/Individual models appear to be associated with students having higher average gain scores compared to nonparticipants. The size of the regression coefficients (varying from 2.21 to 2.79 for reading and from 1.89 to 2.71 for math) as well as the t statistics strongly suggest that our results are important both quantitatively and

TABLE 5

Estimated Partial Regression Coefficients (b)
and t Statistics

Dependent Variables: Average or Median Gain Scores
in Reading and Math

	DEPENDENT VARIABLES							
	AVERAGE GAIN SCORES				MEDIAN GAIN SCORES			
	Reading		Math		Reading		Math	
INDEPENDENT VARIABLES	b	t	b	t	b	t	b	t
INTERCEPT	1.96	.63	2.07	.65	5.12	1.89[b]	3.13	1.03
B	2.43	3.49[a]	2.79	3.96[a]	2.21	3.67[a]	2.71	4.01[a]
C	2.64	3.69[a]	1.89	2.61[a]	2.35	3.81[a]	2.26	3.26[a]
SEX	.14	.06	.84	.33	- .89	- .41	.42	.17
RACE	1.06	1.04	- .98	- .95	1.45	1.64	-1.23	-1.24
EXP	- .03	- .66	- .06	-1.14	- .02	- .56	- .06	-1.24
BA	-1.86	-1.70[b]	1.46	1.33	-2.76	-2.93[a]	.97	.92
BAPLUS	.12	.10	1.91	1.53	-1.41	-1.31	1.51	1.27
MA	.08	.08	1.96	1.98[a]	-1.00	-1.18	1.49	1.57
CSIZE	- .05	-1.26	- .07	-1.71[b]	- .01	- .37	- .06	-1.66[b]
GRADE	- .18	- .91	.11	.55	- .29	-1.71[b]	- .09	- .48
PCTFEMALE	4.04	1.64	- .20	- .08	3.08	1.44	1.19	.50
PCTFRL	-6.63	-5.54[a]	-5.18	-4.27[a]	-8.55	-8.28[a]	-5.61	-4.82[a]
R^2	0.16		0.12		0.26		0.14	
F	5.66[a]		4.00[a]		10.15[a]		4.82[a]	
N	364		364		364		364	

NOTES:
[a] Statistically significant at the 5 percent level, two-tailed test.
[b] Statistically significant at the 10 percent level, two-tailed test.

statistically. In essence, these results suggest that the TIP program appears to have selected the "right" teachers, consistent with the intent of the program.

It is also interesting to note the following results:

1. Teacher's gender does not have a perceptible effect on achievement gain scores.

2. Teacher's race has a small, primarily nonsignificant impact on achievement gain scores, though the effect of race has opposite effects on math and reading scores (black teachers seem to have a small edge in reading but a negative edge in math).

3. The coefficient of EXP is uniformly negative, though not very large and also not statistically significant even at the 10 percent level. We also reestimated the model with both EXP and its square (EXPSQ), but the coefficients of EXPSQ are uniformly nonsignificant.

4. In assessing the effect of education (BA, BAPLUS and MA) on gain scores, it must be remembered that the coefficients in Table 5 are to be compared to the excluded category, which is the level of education beyond MA (call it MAPLUS). Our results suggest that teachers with a BA only are associated with significantly lower reading gain scores in comparison to all others, but that teachers in the BAPLUS or MA categories have reading gain scores roughly similar to those with MAPLUS. Also, the excluded group, MAPLUS, appears to have lower math gain scores compared to all other groups, especially the BAPLUS and MA groups, whereas no significant differences are found among the BA, BAPLUS, and MA groups.

5. We also tested the proposition that experience and education interact in the equation. We formed three new variables, as follows:

BAX = BA x EXP;

BAPLUSX = BAPLUS x EXP; and

MAX = MA x EXP.

In general, the interaction terms were not significant, and other regression results were not materially altered. Also, F tests (Johnston, p. 146) indicate that in none of the equations do the three new variables add a significant contribution to the explanatory power of the model. However, results for mean reading gain scores produce the following equation (t-values in parentheses):

MREAD = 5.34 + 2.33 B + 2.59 C + 0.08 SEX + 0.85 RACE - 0.24 EXP
(1.40) (3.33) (3.64) (0.03) (0.84) (-1.82)

-6.66 BA - 3.59 BAPLUS - 2.72 MA + 0.37 BAX + 0.24 BAPLUSX +
(-2.68) (-1.09) (-1.12) (2.27) (1.21)

0.17 MAX - 0.05 CSIZE - 0.20 GRADE + 5.23 PCTFEMALE -
(1.17) (-1.29) (-1.04) (1.71)

6.49 PCTFRL
(-5.43)

(R^2 = 0.17, F = 4.96, N = 364)

These results suggest that additional years of experience have a net negative effect on reading gain scores for all teachers except those with a BA degree only, for whom the effect is slightly positive (.37 - .24 = .13). Also the marginal effect of BA on reading gain scores is -6.66 + .37 (EXP), suggesting that after 18 years of experience, the effect of BA on achievement is positive.

6. Class size has a negative coefficient throughout, and the effect is significant at the 10 percent level for both mean and median math gain scores. A negative sign suggests that smaller classes are better, a result that is plausible yet not frequently observed.

7. With one exception, grade level has a negative effect (i.e., gain scores decrease at higher grades), but (again with one exception) the results are not statistically significant.

8. Classrooms with a larger percent of females tend to do better, though the results are not statistically significant.

9. As expected, gain scores are much lower in classrooms with a higher percentage of poor students. This result is consistent with the Coleman Report and many other studies emphasizing the effect of socio-economic status on student achievement.

CONCLUDING COMMENTS

Our results clearly demonstrate that participants in TIP are associated with higher gain scores in reading and math than nonparticipants. This suggests that, at least in part, the screening by committees of candidates for a teaching award is consistent with the goals of the program. It is impossible to tell whether our regression results suggest causation - i.e., that award winners influence their students' gain scores - or whether the results merely suggest an association - i.e., that the award winners simply happen to have students who have higher gain scores, and that various factors not analyzed here might play an important role (Berk, 1990). Our guess is that there is at least some causation here, although how much we can obviously not tell without further study.

One must view our results with appropriate caution. First, although we have controlled for "self selection" by introducing a number of teacher and classroom variables and by a judicious selection of the sample of nonparticipants (the control group), there might still be some latent self-selection effect of which we are not aware. Second, although the sample size is adequate for analyses of this type, a larger sample would clearly increase our confidence in the results. Finally, as is true in all empirical analyses, errors in

measurement and specification are unavoidable, so that replication is required if one is to have confidence in the empirical results. Although a study of this type is costly both in state funds and the contribution expected of local school districts, we believe that replication over time is necessary.

REFERENCES

Berk, Ronald A. (1990). "Limitations of using student-achievement data for career-ladder promotions and merit-pay decisions." In *Assessment of Teaching: Purposes, Practices, and Implications for the Profession*, edited by J.V. Mitchel, Jr., S.L. Wise, and B.S. Plake, pp. 261-306. Hillsdale, NJ: Lawrence Erlbaum.

Cohn, Elchanan and Terry G. Geske (1990) *Economics of Education*, 3rd ed. Oxford: Pergamon.

Hanushek, Eric A. (1986) "The Economics of Schooling: Production and Efficiency in Public Schools." *Journal of Economic Literature* 24 (September): 1141-77.

Johnson, S.M. (1984). "Merit pay for teachers: A poor prescription for reform." *Harvard Educational Review* 54 (May): 175-85.

Johnston, J. (1972) *Econometric Methods*. New York: McGraw-Hill.

MGT of America, Inc. (1989). *An Evaluation of the Teacher Incentive Program 1987-88 Pilot-Test Following the Payment of Incentive Awards and an Initial Assessment of Statewide Implementation of the Teacher Incentive Program in 1988-89*. Tallahassee: author.

Monk, David H. (1990) *Educational Finance: An Economic Approach*. New York: McGraw-Hill.

Murnane, Richard J. and David K. Cohen (1984). "Merit pay and the evaluation problem." *Harvard Educational Review* 54 (May): 1-17.

Olsen, L. (1987). "Performance pay: New round for an old debate." *Education Week* (March 12): 1, 18-20.